

Comparison of Tindal food samples with PFAS trigger levels

Prepared for Northern Territory Department of Health

By

Food Standards Australia New Zealand

September 2018

Table of Contents

1. Background.....	1
2. Analytical data	1
3. Comparison with trigger levels proposed by FSANZ	5
4. Serves of food to reach the health based guidance value for PFOS	10
5. Conclusion.....	10
Attachment 1	21
Attachment 2	25
Attachment 3	26

1. Background

The Northern Territory Department of Health has requested that Food Standards Australia New Zealand (FSANZ) review per- and poly-fluoroalkylated substances (PFAS) analytical data for fish and seafood samples caught in waters close to the Tindal base (river sites) and some other foods from the Katherine area and compare these data to the trigger levels proposed by FSANZ.

In April 2017 the Australian Department of Health published FSANZ's recommendations on appropriate tolerable daily intakes (TDIs) for perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA). Insufficient evidence was available to establish a TDI for perfluorohexane sulfonate (PFHxS), but FSANZ recommended that the TDI for PFOS should be used, meaning that PFOS and PFHxS concentrations should be summed for the purposes of risk assessment. In addition, FSANZ proposed 'trigger levels' for a range of food groups which indicate concentrations above which further consideration may be warranted by regulatory agencies. These reports were published on the Australian Department of Health website¹. For this report additional trigger levels are proposed for poultry meat.

2. Analytical data

PFAS analytical data were provided to FSANZ for produce from the Tindal-Katherine area, including fish and seafood, animal products, fruit and vegetables. Where duplicate and triplicate analyses were supplied for the same food sample, these values were averaged before further data analysis. A small number of fish samples were excluded from the database prepared for the dietary exposure assessment where the sample was for a small whole fish and not flesh only. For fish flesh, fish livers, crustacea, chicken meat and chicken egg a small proportion of analytical results were for a composite sample. In these cases the analytical value was replicated in the database the same number of times as the number of contributing sub-samples.

For most of the data reported the level of reporting (LOR) was 0.3 µg/kg for PFOS and PFHxS and 0.5 µg/kg for PFOA. Non-detect results were assigned the LOR to enable upper bound mean and median values to be calculated; for non-detect results for PFOS+PFHxS combined a value of 0.6 µg/kg was assigned. Lower LORs were achieved by some laboratories for a few food matrices and occasionally the LOR was higher because the sample size was too small to achieve the standard LOR. These differences are noted in the text where relevant. For the purposes of this analysis, non-detect results were assigned the LOR as reported for that individual food sample, with no statistical adjustment made where different LORs were reported for the same food/chemical matrix.

2.1. Aquatic biota

PFAS analytical data were provided for 487 fish and crustacea samples caught in the Katherine area from October 2016 to April 2018. Following data preparation 299² data points for fish flesh, 44 for fish liver and 55 for crustacea were available in the database for further analysis following data clean up.

Thirteen species of fish were analysed including 2 diadromous fish (Barramundi, Tarpon) and 11 freshwater fish (Archerfish, Barred Grunter, Black Catfish, Blue Catfish, Bony Bream, Butler's Grunter, Catfish, Mullet, Ord River Mullet, Sleepy Cod and Sooty Grunter). Fish flesh was analysed for all samples and fish liver for 7 species, livers for Archerfish, Barred Grunter, Black Catfish and Catfish were not sampled.

Two crustacean species were analysed; whole cherabin (freshwater prawn) and whole inland freshwater crabs.

Data provided indicated that PFOS was detected at levels greater than the level of reporting (LOR of 0.3 µg/kg) in 287 of the 299 fish flesh samples, 43 of the 44 fish liver samples and in all of the 55 crustacea samples. PFAS concentrations for the other two congeners considered in this report PFOA and PFHxS, indicated a higher proportion of results less than the relevant level of reporting compared to PFOS. PFOA

¹ See Department of Health: Health Based Guidance Values for Per- and Poly Fluoroalkyl Substances <http://www.health.gov.au/internet/main/publishing.nsf/Content/ohp-pfas-hbgv.htm>

² Four samples were not analysed for PFHxS and were therefore excluded from calculation of PFOS+PFHxS

was detected at levels less than the LOR of 0.5 µg/kg for most samples analysed. Of the samples analysed PFOA was not detected in any of the 299 fish flesh samples, in 2 of the 44 fish liver samples and in none of the 55 crustacea samples. PFHxS was detected at levels greater than the LOR of 0.3 µg/kg in 47 of the 295 fish flesh samples, in 19 of the 44 fish liver samples and 47 crustacea samples.

2.2. Animal products

PFAS analytical data were available for poultry eggs (chicken, duck, turkey), poultry meat (chicken, duck) and for serum from cattle, sheep, pigs, goats and chickens. Approximately 5 mL serum was taken from each animal, or from a group of smaller animals, following recommended phlebotomy practices for the collection of blood and separation of serum. A conversion factor of 12 was applied to convert the serum analytical results to meat flesh equivalents, since the concentration in flesh is lower than that found in serum, noting this is the lowest and hence more conservative value reported amongst all the species for conversion of serum PFAS values to meat equivalents (Ehler S, 2012³).

Data for mammalian meat indicated that PFOS was detected at levels greater than the LOR of 0.3 µg/kg for all of the 31 samples, greater than the LOR of 0.5 µg/kg for PFOA for 10 of the 31 samples and greater than the LOR of 0.3 µg/kg for PFHxS in 29 of the 31 samples.

Data provided for poultry eggs indicated that PFOS was detected at levels greater than LOR of 0.3 µg/kg for 60 of the 75 samples and greater than the LOR of 0.3 µg/kg for PFHxS in 38 of 75 samples. None of the 75 poultry egg samples had PFOA levels greater than the LOR of 0.5 µg/kg.

Data provided for poultry meat indicated that PFOS was detected at levels greater than LOR of 0.3 µg/kg for 23 of the 29 samples, and greater than the LOR of 0.3 µg/kg for PFHxS in 23 of the 29 samples. None of the 29 poultry meat samples had PFOA levels greater than the LOR of 1.0 µg/kg

2.3. Fruit and vegetables

Limited PFAS analytical data were available for 14 fruit species (60 data points) and 20 vegetable species (58 data points). Data provided indicated that PFAS (PFHxS, PFOA or PFOS) was detected in a small number of the fruit and vegetables samples analysed.

Data provided for fruit indicated that PFOS was detected at levels greater than the LOR of 0.5 µg/kg in 4 of the 60 samples, greater than the LOR of 0.3 µg/kg for PFOA in 4 of 60 samples. None of the 60 fruit samples had PFHxS levels greater than the LOR of 0.3 µg/kg.

Data provided for vegetables indicated that PFOS was detected at levels greater than LOR of 0.3 µg/kg in 15 of the 58 samples, greater than the LOR of 0.3 µg/kg, for PFOA in 1 of the 58 samples and greater than the LOR of 0.3 µg/kg for PFHxS in 7 of the 58 samples.

2.4. Summary of analytical data

Summary data for PFOS, PFOA, PFHxS and PFOS+PFHxS combined for fish and seafood are provided in Table 1. Table 2 provides PFOS + PFHxS combined summary data for each individual aquatic species analysed with a sample size of ≥25, detailed results for other species with lower sample numbers are at Attachment 1. As reported elsewhere in the world, PFAS levels were generally higher on average in freshwater fish species than in diadromous fish⁴.

Summary data for PFOS, PFOA, PFHxS and PFOS+PFHxS combined for animal products are provided in Table 3. Table 4 provides summary PFOS + PFHxS combined summary data for animal species analysed with a sample size of ≥25, detailed results for other species with lower sample numbers are at

³ Susan Ehler (2012) Analytik on Perfluoroalkylsäuren in verschiedenen Matrices zur Klärung der Toxikokinetik in Tierarten, die der Lebensmittelgewinnung dienen. (Analysis of Purfluoroalkyl acids in different matrices for clarifying the toxicokinetics in animal species that are used for food production) PhD Thesis Westfälische Wilhelm-Universität Münster, Submitted 2012

⁴ Attachment 1 to Supporting Document 2 of Department of Health Consolidated Report on PFAS, titled Occurrence of and dietary exposure to PFOS, PFOA and PFHxS reported in the literature <http://www.health.gov.au/internet/main/publishing.nsf/Content/ohp-pfas-hbgv.htm>

Attachment 1. Summary data for fruit and vegetables are provided in Table 5 with detailed results for fruit and vegetable species also at Attachment 1.

Table 1 PFAS concentration data (µg/kg) for Tindal fish and seafood

Matrix	Chemical	Count	Count of <LOR	Minimum	Maximum	Mean**	Median**
Fish Flesh*	PFHxS	295	248	<LOR	4.1	0.4	0.3
	PFOA	299	299	<LOR	0	0.5	0.5
	PFOS	299	12	<LOR	380	37.8	17.0
	PFOS+PFHxS	295	12	<LOR	380.5	38.3	17.3
Fish liver*	PFHxS	44	25	<LOR	6	0.8	0.3
	PFOA	44	42	<LOR	0.7	0.5	0.5
	PFOS	44	1	<LOR	1400	186	98.5
	PFOS+PFHxS	44	1	<LOR	1406	186.8	98.8
Crustacea*	PFHxS	55	8	<LOR	5.9	2.7	3.2
	PFOA	55	55	<LOR	0	0.4	0.5
	PFOS	55	0	0.7	87	43.5	44.0
	PFOS+PFHxS	55	0	0.7	90.2	46.2	49.9

*All species combined

** Upper bound mean and median derived where not detected results are assigned a concentration equal to LOR (LOR of 0.3 µg/kg for PFOS, PFHxS, 0.5 µg/kg for PFOA unless otherwise reported).

Table 2 Summary PFAS concentration data (µg/kg) by aquatic species with a sample size ≥25

Matrix*	Chemical	Count	Count of <LOR	Minimum	Maximum	Mean**	Median**
Barramundi	PFHxS	65	65	<LOR	<LOR	0.3	0.3
	PFOA	67	67	<LOR	<LOR	0.5	0.5
	PFOS	67	3	<LOR	62.0	15.4	11.0
	PFOS+PFHxS	65	3	<LOR	62.3	15.6	9.9
Black Catfish	PFHxS	37	13	<LOR	4.1	1.0	0.6
	PFOA	37	37	<LOR	<LOR	0.5	0.5
	PFOS	37	1	<LOR	200.0	54.9	26.0
	PFOS+PFHxS	37	1	<LOR	204.1	56.0	26.5
Bony Bream	PFHxS	54	45	<LOR	0.7	0.3	0.3
	PFOA	54	54	<LOR	<LOR	0.5	0.5
	PFOS	54	4	<LOR	150.0	33.2	12.5
	PFOS+PFHxS	54	4	<LOR	150.3	33.6	12.8
Cherabin (whole)	PFHxS	39	8	<LOR	3.2	1.7	1.2
	PFOA	39	39	<LOR	0.0	0.5	0.5
	PFOS	39	0	0.7	87.0	45.6	53.0
	PFOS+PFHxS	39	0	0.7	90.2	47.4	54.2
Ord River Mullet	PFHxS	31	25	<LOR	0.6	0.3	0.3
	PFOA	31	31	<LOR	<LOR	0.5	0.5
	PFOS	31	0	0.9	380.0	68.7	18.0
	PFOS+PFHxS	31	0	0.9	380.5	69.0	18.3
Sleepy Cod	PFHxS	36	36	<LOR	<LOR	0.3	0.3
	PFOA	36	36	<LOR	<LOR	0.5	0.5
	PFOS	36	4	<LOR	88.0	19.9	11.5
	PFOS+PFHxS	36	4	<LOR	88.3	20.2	11.8
Sooty Grunter	PFHxS	37	37	<LOR	<LOR	0.3	0.3
	PFOA	37	37	<LOR	<LOR	0.5	0.5
	PFOS	37	0	0.3	78.0	20.0	14.0
	PFOS+PFHxS	37	0	0.3	78.3	20.3	14.3

** Upper bound mean and median derived where not detected results are assigned a concentration equal to LOR (LOR is 0.3 µg/kg for PFOS, PFHxS, 0.5 µg/kg for PFOA unless otherwise reported).

* Fish flesh for all species except cherabin (whole)

Table 3 Summary PFAS concentration data (µg/kg) for animal products

Matrix	Chemical	Count	Count of <LOR	Minimum	Maximum	Mean**	Median**
Meat mammalian*	PFHxS	31	2	<LOR	1.8	0.6	0.5
	PFOA	31	21	<LOR	1.0	0.7	1.0
	PFOS	31	0	0.3	10.8	2.7	1.8
	PFOS+PFHxS	31	0	0.3	11.5	3.3	2.5
Poultry eggs*	PFHxS	75	37	<LOR	9.1	1.6	0.4
	PFOA	75	75	<LOR	<LOR	0.5	0.5
	PFOS	75	15	<LOR	100.0	11.4	1.0
	PFOS+PFHxS	75	15	<LOR	106.9	13.8	6.1
Poultry meat*	PFHxS	29	6	<LOR	1.2	0.5	0.4
	PFOA	29	29	<LOR	<LOR	1.0	1.0
	PFOS	29	6	<LOR	5.0	1.2	1.0
	PFOS+PFHxS	29	6	<LOR	6.2	1.8	1.8

* All species combined

**Upper bound mean and median derived where not detected results are assigned a concentration equal to LOR (LOR of 0.3 µg/kg for PFOS and PFHxS, 0.5 µg/kg for PFOA, except for all serum conversion measures where the LOR is 1.0 µg/kg for all PFAS congeners)

Table 4 Summary PFOS+PFHxS concentration data (µg/kg) for animal products with a sample ≥25

Matrix	Chemical	Count	Count of <LOR	Minimum	Maximum	Mean*	Median*
Chicken eggs	PFOS+PFHxS	67	14	<LOR	55.6	9.3	3.8
Chicken meat	PFOS+PFHxS	26	6	<LOR	1.8	1.3	1.1

Table 5 Summary PFAS concentration data (µg/kg) for fruit and vegetables

Matrix	Chemical	Count	Count of <LOR	Min	Max	Mean**	Median**
Fruit*	PFHxS	60	60	<LOR	<LOR	0.3	0.3
	PFOA	60	56	<LOR	1.7	0.3	0.3
	PFOS	60	56	<LOR	1.7	0.5	0.5
	PFOS+PFHxS	60	56	<LOR	2.0	0.8	0.8
Vegetables*	PFHxS	58	51	<LOR	1.8	0.4	0.3
	PFOA	58	57	<LOR	0.5	0.5	0.5
	PFOS	58	43	<LOR	5.7	0.6	0.3
	PFOS+PFHxS	58	42	<LOR	7.5	0.9	0.6

*All species combined, edible portion analysed

**Upper bound mean and median derived where not detected results are assigned a concentration equal to LOR (PFHxS LOR of 0.3 µg/kg; PFOA LOR of 0.3 µg/kg for fruit except cucurbits and some vegetables, otherwise LOR of 0.5 µg/kg; PFOS LOR of 0.3 µg/kg for vegetables except LOR of 1.0 µg/kg for green beans, otherwise 0.5 µg/kg for the fruit and tree nut)

3. Comparison with trigger levels proposed by FSANZ

3.1. Fish flesh

Trigger levels developed by FSANZ are provided at Attachment 2. Trigger levels of 5.2 µg/kg for PFOS+PFHxS combined and 41 µg/kg for PFOA were proposed for all finfish. These are conservative values based on high (90th percentile) consumption of all diadromous, freshwater and marine fish by children aged 2-6 years.

PFOA

None of the 299 fish flesh data points for Tindal had detected concentrations of PFOA, with all samples <LOR of 0.5 µg/kg⁵.

PFOS+PFHxS

Two hundred and eighty three of the 295 fish flesh data points had detected concentrations of PFOS+PFHxS combined, with the remaining 12 samples <LOR of 0.3 µg/kg for PFOS and PFHxS.

For the 6 individual fish flesh species with ≥25 samples, the respective upper bound median values for fish flesh exceeded the trigger level of 5.2 µg/kg (Barramundi 9.9 µg/kg, Black Catfish 26.5 µg/kg, Bony Bream 12.8 µg/kg, Ord River Mullet 18.3 µg/kg, Sleepy Cod 11.8 µg/kg and Sooty Grunter 14.3 µg/kg). Of these 6 species, 208/260 (80%) data points exceeded the trigger level with the maximum value reported of 380.5 µg/kg for Ord River Mullet, well above the trigger level. This indicates that consumption of these fish species caught in waters near Katherine over time may present a public health and safety concern if they are regularly consumed and these fish should therefore continue to be monitored for PFAS.

For other fish species the number of data points was < 25 so results need to be considered in light of these small sample numbers. Further investigation or risk management action may be required in relation to several fish species exceeding the finfish trigger level at median PFOS+PFHxS combined concentrations, as detailed below.

For the other diadromous fish analysed in addition to Barramundi, the upper bound median level of PFOS+PFHxS combined for Tarpon of 190.8 µg/kg (2 samples) exceeded the finfish trigger level of 5.2 µg/kg.

For the eleven freshwater fish analysed, the upper bound median level of PFOS+PFHxS combined exceeded the finfish trigger level of 5.2 µg/kg in all cases, Archerfish (50.6 µg/kg, 2 samples), Barred Grunter (23.8 µg/kg, 8 samples), Blue Catfish (12.3 µg/kg, 6 samples), Butler's Grunter (100.3 µg/kg, 6 samples), Catfish (34.3, 1 sample) and Mullet (89.8 µg/kg, 10 samples).

When all fish species analysed were considered together the upper bound median value of 17.3 µg/kg for fish flesh for all species combined exceeded the trigger level of 5.2 µg/kg. This indicates that, overall, consumption of a range of these fish species from the Katherine area over time may present a public health and safety concern if these species are consumed on a regular basis⁶.

3.2. Fish liver

Trigger levels of 280 µg/kg for PFOS+PFHxS combined and 2240 µg/kg for PFOA were proposed for all fish liver (Attachment 2). These are conservative values based on the consumption of one liver (5 g weight).

PFOA

2 of the 44 fish liver data points had detected concentrations of PFOA, with the remaining 42 samples <LOR of 0.5 µg/kg. Detections were reported for Bony Bream liver (0.6 µg/kg, 1 sample) and Mullet liver (0.7 µg/kg, 1 sample) but these were well below the PFOA trigger level of 2240 µg/kg. Archerfish, Barred Grunter, Black Catfish, and Catfish livers were not analysed.

⁵ LOR for PFOA for some barramundi samples from one laboratory was lower (0.3 µg/kg) than the standard LOR of 0.5 µg/kg.

⁶ The use of the median concentration level reflects that there will always be a distribution of the contaminant in the foods eaten over time. It is unrealistic to expect each food item consumed to be contaminated at the highest reported concentration on every eating occasion.

PFOS+PFHxS

For fish liver 43 of 44 data points for PFOS+PFHxS combined had detected concentrations.

For all fish species the number of data points was < 25 so results need to be considered in light of these small sample numbers. Further investigation or risk management action may be required in relation to two fish species exceeding the fish liver trigger level at median PFOS+PFHxS combined concentrations, as detailed below.

For the one diadromous fish analysed, the upper bound median level of PFOS+PFHxS combined for Barramundi liver of 100.3 µg/kg (17 samples) did not exceed the fish liver trigger level of 280 µg/kg.

The livers of seven freshwater fish were analysed, the upper bound median level of PFOS+PFHxS combined exceeded the fish liver trigger level of 280 µg/kg for Butler's Grunter liver (300.6 µg/kg, 1 sample) and Mullet liver (741.7 µg/kg, 2 samples). The trigger level was not exceeded for livers of the remaining five species: Blue Catfish, Bony Bream, Ord River Mullet, Sleepy Cod, and Sooty Grunter (details in Attachment 1). Archerfish, Barred Grunter, Black Catfish, and Cherabin livers were not analysed.

When the livers for all fish species analysed were considered together the upper bound median⁵ PFOS+PFHxS combined concentration was 98.8 µg/kg, less than the trigger level of 280 µg/kg. This indicates that, overall, consumption of livers from a range of these fish species over time is unlikely to present a public health and safety concern⁵.

3.3. Crustacea

Trigger levels of 65 µg/kg for PFOS+PFHxS combined and 520 µg/kg for PFOA were proposed for crustacea and molluscs (Attachment 2). These are conservative values based on the median consumption of crustacea for children aged 2-6 years.

PFOA

None of the 39 cherabin samples or 16 Inland Freshwater Crab samples had detected concentrations of PFOA.

PFOS+PFHxS

For cherabin, the only crustacea species with ≥25 samples, all samples had detections of PFOS+PFHxS combined. The upper bound median value for cherabin data for PFOS+PFHxS combined of 54.2 µg/kg was lower than the trigger level of 65 µg/kg. All 16 Freshwater Crab data points had detected concentrations of PFOS+PFHxS combined. The upper bound median value for Inland Freshwater Crab data for PFOS+PFHxS combined of 43.5 µg/kg was lower than the trigger level of 65 µg/kg. Based on limited data, this indicates that, overall, consumption of crustacea over time is unlikely to present a public health and safety concern⁵.

3.4. Animal products

Trigger levels of 3.5 µg/kg for PFOS+PFHxS combined and 28 µg/kg for PFOA were proposed for mammalian meat and 11 µg/kg for PFOS+PFHxS combined and 85 µg/kg for PFOA for poultry eggs (Attachment 2). At the time of previous reports trigger levels were not proposed for poultry meat as it had not been analysed for PFAS, but using the same approach, trigger levels of 4 µg/kg for PFOS+PFHxS combined and 32 µg/kg for PFOA are now proposed for poultry meat. These are conservative values based on the 90th percentile consumption of all mammalian meat, poultry eggs and poultry meat for children aged 2-6 years.

PFOA

Ten of the 31 mammalian meat data points (meat equivalents from serum data) had detected concentrations of PFOA (LOR of 0.5 µg/kg), the three sheep samples had no detects. The upper bound

median level for all species combined of PFOA of 1 µg/kg did not exceed the trigger level of 29 µg/kg for PFOA, the maximum reported concentration for cattle, goat and pig data was 1 µg/kg.

None of the 75 samples of poultry eggs or 29 samples of poultry meat had detected concentrations of PFOA (LOR of 0.5 µg/kg).

PFOS+PFHxS

Mammalian meat

All of the 31 mammalian meat data points (meat equivalents from serum data) had detected concentrations of PFOS+PFHxS (LOR of 0.3 µg/kg for PFOS or PFHxS, LOR 0.6 PFOS+PFHxS combined). Serum from cattle, goat, pigs and sheep was analysed and results converted to meat equivalents (see section 2).

The number of data points for individual mammalian species were < 25 so results need to be considered in light of these small sample numbers. For the four types of species analysed, the upper bound median levels of PFOS+PFHxS combined for goat (4.6 µg/kg, 9 samples) exceeded the mammalian meat trigger level of 3.5 µg/kg, but upper bound median levels of PFOS+PFHxS combined for cattle (2.9 µg/kg, 14 samples), pigs (1.2 µg/kg, 5 samples) and sheep (1.2 µg/kg, 3 samples) did not exceed the trigger level. The maximum levels reported for goat 11.5 µg/kg and cattle 8.9 µg/kg exceeded the trigger level, but those for pigs and sheep did not.

For mammalian meat, the upper bound median level of PFOS+PFHxS combined of 2.5 µg/kg is less than the trigger level of 3.5 µg/kg and, overall, indicates consumption of a range of mammalian meats over time is unlikely to present a public health and safety concern⁵. However, as some individual results exceeded the trigger level for PFOS+PFHxS combined, mammalian animals should continue to be monitored for PFAS.

Poultry eggs

Sixty of the 75 poultry eggs data points had detected concentrations of PFOS+PFHxS (LOR of 0.3 µg/kg for PFOS or PFHxS, LOR 0.6 PFOS+PFHxS combined). Chicken, duck and turkey eggs were analysed.

For the chicken eggs analysed, the upper bound median levels of PFOS+PFHxS combined was 3.8 µg/kg (67 samples), which did not exceed the trigger level of 11 µg/kg for poultry eggs. Of these samples 21/67 (31%) exceeded the trigger level, with the maximum level reported of 55.6 µg/kg.

The number of data points for other poultry eggs were < 25 so results need to be considered in light of these small sample numbers. For the two other species analysed, the upper bound median levels of PFOS+PFHxS combined for duck eggs (48.1 µg/kg, 7 samples) and turkey egg (46.1 µg/kg, 1 sample) both exceeded the poultry eggs trigger level of 11 µg/kg. The maximum level reported for duck eggs was 106.9 µg/kg.

For poultry eggs, the upper bound median level of PFOS+PFHxS combined of 6.1 µg/kg is less than the trigger level of 11 µg/kg and, overall, indicates consumption of a range of poultry eggs over time is unlikely to present a public health and safety concern⁵. However, as some individual results exceeded the trigger level for PFOS+PFHxS combined, poultry eggs should continue to be monitored for PFAS.

Poultry meat

Twenty three of the 29 poultry meat data points had detected concentrations of PFOS+PFHxS (LOR of 0.3 µg/kg for PFOS or PFHxS, LOR 0.6 PFOS+PFHxS combined). Chicken and duck meat were analysed.

For the chicken meat analysed, the upper bound median levels of PFOS+PFHxS combined was 1.1 µg/kg (26 samples), which did not exceed the trigger level of 4 µg/kg proposed for poultry meat. The maximum level reported of 2 µg/kg did exceed the trigger level.

The number of data points for duck meat were < 25 so results need to be considered in light of the small sample number. For the duck meat analysed, the upper bound median levels of PFOS+PFHxS combined was 6.2 µg/kg (3 samples), which exceeded the proposed poultry meat trigger level of 4 µg/kg. The maximum level reported for duck meat was 6.2 µg/kg.

For poultry meat, the upper bound median level of PFOS+PFHxS combined of 1.8 µg/kg is less than the trigger level of 4 µg/kg and, overall, indicates consumption of a range of poultry meat over time is unlikely to present a public health and safety concern⁵. However, as the limited data for duck meat exceeded the trigger level for PFOS+PFHxS combined, duck meat should continue to be monitored for PFAS.

3.5. Fruit

Trigger levels of 0.6 µg/kg or LOD if higher for PFOS+PFHxS combined and 5.1 µg/kg for PFOA were proposed for fruit (Attachment 2). These are conservative values based on the 90th percentile consumption of all fruit for children aged 2-6 years.

PFOA

One of the 14 types of fruit sampled had detected concentrations of PFOA (LOR of 0.3 µg/kg); mango with 4 of 24 samples having reported concentrations, the upper median bound level was 0.3 µg/kg and the maximum was 1.7 µg/kg. This was well below the trigger level of 5.1 µg/kg for PFOA.

The remaining 13 fruit had no detected PFOA (<LOR of 0.3 µg/kg). Berries (mulberry, 3 samples), citrus (grapefruit, 2 samples; lemon, 4 samples; lime 5 samples), cucurbits (melon, 1 sample; watermelon, 1 sample), tropical fruit edible peel (Dragon Fruit, 1 sample; Starfruit, 1 sample) and tropical fruit inedible peel (banana, 5 samples; black sapote, 1 sample; custard apple, 1 sample; jackfruit 1 sample; longan, 1 sample; pawpaw, 7 samples) were analysed.

PFOS+PFHxS

One of the 14 types of fruit sampled, mango, had detected concentrations of PFOS+PFHxS (LOR of 0.5 µg/kg for PFOS, 0.3 PFHxS µg/kg). Four of 24 samples of mango had reported concentrations, the upper median level was 0.8 µg/kg and the maximum 1.7 µg/kg. This was above the trigger level of 0.8 µg/kg for PFOS+PFHxS combined.

The upper median level for all fruit was 0.8 µg/kg, which would be considered at the trigger level for this survey as it is the LOD for PFOS+PFHxS combined.

The number of data points for individual species were < 25 so results need to be considered in light of these small sample numbers. The available results indicate that, overall, consumption of fruit from a range of these species over time is unlikely to present a public health and safety concern⁵.

3.6. Vegetables

Trigger levels of 1.1 µg/kg or LOD if higher for PFOS+PFHxS combined and 8.8 µg/kg for PFOA were proposed for vegetables (Attachment 2). These are conservative values based on the 90th percentile consumption of all vegetables for children aged 2-6 years.

PFOA

One of the 20 vegetables sampled, tomato (11 samples) had detected concentrations of PFOA (LOR of 0.5 µg/kg or 0.3 µg/kg for some samples). The remaining vegetables sampled had no reported detections. Three herbs (basil, chives, lemongrass 1 sample each), three leafy vegetables (spinach, 7 samples; Moringa, 1 sample; drumstick 1 sample), five other fruiting vegetables (capsicum, 1 sample; chilli, 2 samples; corn, 1 sample; eggplant, 5 samples; okra, 1 sample), six root and tuber vegetables (beetroot, 1 sample; carrot, 2 samples; cassava, 2 samples; radish, 1 sample; sweet potato 7 samples; taro 5 samples) and one tree nut (coconut, 2 samples) were analysed.

PFOS+PFHxS

Nine of the 20 vegetables sampled had detected concentrations of PFOS+PFHxS (0.3 µg/kg for PFHxS; LOR of 0.3 µg/kg or 0.5 µg/kg for PFOS except for green beans where LOR was 1.0 µg/kg). The maximum

levels reported for chives (1.2 µg/kg, 1 sample) and taro (2.6 µg/kg, 5 samples) exceeded the trigger level for vegetables.

The upper bound median for all vegetables was 0.6 µg/kg, which is less than the trigger level of 1.1 µg/kg. The number of data points for individual species were < 25 so results need to be considered in light of these small sample numbers. The available results indicate that, overall, consumption of vegetables from a range of these species over time is unlikely to present a public health and safety concern⁵.

4. Serves of food to reach the health based guidance value for PFOS

To provide additional context, Tables 6-9 below provide an indication of the approximate number of serves of fish flesh, fish liver, crustacea (with a sample size ≥25), animal products, fruit and vegetables with median PFOS+PFHxS combined concentrations that can be consumed by the whole population aged 2+ years before reaching the TDI for PFOS of 0.02 µg/kg bw/day on a food by food basis. Attachment 3 provides similar information for all aquatic biota species.

Similar information is given in Tables 10-13 for children aged 2-6 years.

For all tables, the grams per day, number of serves per day, week or month have been rounded down, to be conservative. For foods where there were no detects in any of the samples, the grams per day, number of serves per day and week are based on an upper bound median where non-detect results for PFOS and PFHxS were both assigned the reported LOR. This gives a conservative estimate of the amount of food that can be consumed, as actual levels of these PFAS chemicals are likely to be < LOR.

5. Conclusion

On the basis of the limited data provided, it is concluded that overall, exposure to PFAS from consumption over time of most foods sourced or grown in the Tindal-Katherine area, including mammalian meat, poultry eggs, poultry meat, fruit, vegetables, fish liver and crustacea, is unlikely to present a public health and safety concern.

Whilst the reported median fish flesh PFOS+PFHxS concentrations exceeded the trigger level for fish flesh for all species sampled from the Tindal-Katherine area, several serves of most species can be consumed each week before reaching the TDI for PFOS. Three species (Tarpon, Butler's Grunter and Mullet) should only be consumed on a monthly basis and two species (Archerfish, Catfish) only once a week because of high reported levels of PFOS+PFHxS combined.

Given the exceedance of the trigger level for PFOS+PFHxS for median fish flesh concentrations, the high proportion of individual samples exceeding the trigger level and the low numbers of fish sampled, further monitoring may be required for all fish species caught in the Katherine area (fish flesh and liver). Regular consumption of Tarpon, Archerfish, Butler's Grunter, Catfish and Mullet alone should be avoided, rather a range of species should be consumed over time where possible.

While this report details that it is safe to consume several serves of some types of fish from the Tindal-Katherine area, FSANZ nonetheless recommends that due to health concerns regarding naturally occurring mercury levels in fish, that people limit their consumption of fish in accordance with national fish consumption advice produced by FSANZ, which can be downloaded at:

<http://www.foodstandards.gov.au/consumer/chemicals/mercury/documents/mif%20brochure.pdf>

Table 6 Amount of fish, fish livers and crustacea with a sample size ≥ 25 at median PFOS+PFHxS combined concentration that can be consumed every day over a lifetime before reaching the TDI* for the population aged 2+ years (expressed as grams/day, serves/day^ and frequency of consumption)

Matrix	Fish species	Amount of food that can be consumed before reaching PFOS+PFHxS TDI			Actual food consumption~ (grams/day)	
		Grams/day	Serves of foods /day	Approximate frequency of consumption	P90 (consumers only)	Mean (consumers only)
Fish flesh	All species	80	Approx ½ fillet (1 fillet/cutlet = 150 g)	About 3 serves of a range of fish per week	123	45
	<i>Diadromous fish</i>	123	Approx 4/5 fillet (1 fillet/cutlet = 150 g)	About 5 serves of a range of fish per week		
	Barramundi	141	Approx 9/10 fillet (1 fillet/cutlet = 150 g)	About 6 serves of Barramundi per week		
	<i>Freshwater fish</i>	72	Approx 1/3 fillet (1 fillet/cutlet = 150 g)	About 3 serves range of fish per week		
	Black Catfish	52	Approx 1/3 fillet (1 fillet/cutlet = 150 g)	About 2 serves of Black Catfish per week		
	Bony Bream	109	Approx 3/4 fillet (1 fillet/cutlet = 150 g)	About 5 serves of Bony Bream per week		
	Ord River Mullet	76	Approx ½ fillet (1 fillet/cutlet = 150 g)	About 3 serves of Ord River Mullet per week		
	Sleepy Cod	118	Approx 3/4 fillet (1 fillet/cutlet = 150 g)	About 5 serves of Sleepy Cod per week		
	Sooty Grunter	97	Approx ½ fillet (1 fillet/cutlet = 150 g)	About 4 serves of Sooty Grunter per week		
Fish liver	All species	14	Approx 2½ livers (1 liver = 5 g)	About 19 livers from a range of fish per week		5 [#]
	<i>Diadromous fish</i>	13	Approx 2½ livers (1 liver = 5 g)	About 19 livers from a range of fish per week		
	<i>Freshwater fish</i>	14	Approx 2½ livers (1 liver = 5 g)	About 20 livers from a range of fish per week		
Crustacea	Cherabin	25	Approx 2 serves (1 serve cherabin meat = 11 g)	About 16 serve of cherabin per week	63	21

^ Measures taken from AUSNUT 2011-12 Measures File [AUSNUT Food Measures File](#)

* Tolerable daily intake for PFOS and PFOS+PFHxS combined is 0.02 µg/kg body weight/day

~ Actual food consumption for all fish and seafood as reported in the 2011-12 Australian National Nutrition and Physical Activity Survey

no food consumption data available, Population 2+ years, median consumption assumed to be 5 g (weight of one liver). Source: FSANZ report on Edith River, Northern Territory 2013, https://dpir.nt.gov.au/_data/assets/pdf_file/0006/260187/TraceElementsNTFish.pdf

Table 7 Amount of animal products at median PFOS+PFHxS combined concentration that can be consumed every day over a lifetime before reaching the TDI* for the population aged 2+ years (expressed as grams/day, serves/day^ and frequency of consumption)

Matrix	Species	Amount of food that can be consumed before reaching PFOS+PFHxS TDI			Actual food consumption~ (grams/day)	
		Grams/day	Serves of foods /day	Approximate frequency of consumption	P90 (consumers only)	Mean (consumers only)
Mammalian meat	Freshwater Crab	32	Approx 2½ serves (1 serve crab meat = 11 g)	About 20 serves crab meat per week		
	Cattle	482	Approx 2 beef steaks (1beef steak = 200 g)	About 16 serves of beef per week	163	71
	Goat#	304	Approx 2½ serves goat meat (1 serve goat pieces = 120 g)	About 17 serves of goat per week	286	140
	Pigs#	1166	Approx 9½ pork steaks (1 pork steak = 120 g)	About 68 serves of pork per week	89	33
	Sheep#	1166	Approx 25 lamb chops (1 loin chop, medium = 45 g)	About 181 serves of lamb per week	85	22
Poultry eggs	Chicken	368	Approx 7 chicken eggs (1 large chicken egg = 50 g)	About 51 chicken eggs per week	58	22
	Duck#	29	Approx 2/5 duck egg (1 duck egg = 60g)	About 3 duck eggs per week	105	43
	Turkey#	30	Approx ½ turkey egg (1 turkey egg = 50 g)	About 3 turkey eggs per week		
Poultry meat	Chicken	1272	Approx 10½ serves chicken (1 serve chicken pieces = 120 g)	About 74 serves chicken per week	172	73
	Duck#	225	Approx 2½ serves duck (1 serve duck pieces = 90 g)	About 17 serves duck per week	101	53

^ Measures taken from AUSNUT 2011-12 Measures File [AUSNUT Food Measures File](#)

* Tolerable daily intake for PFOS and PFOS+PFHxS combined is 0.02 µg/kg body weight/day

~ Actual food consumption as reported in the 2011-12 Australian National Nutrition and Physical Activity Survey

Limited data (< 10 data points)

Table 8 Amount of fruit at median PFOS+PFHxS combined concentration that can be consumed every day over a lifetime before reaching the TDI* for the population aged 2+ years (expressed as grams/day, serves/day^ and frequency of consumption)

Matrix	Species	Amount of food that can be consumed before reaching PFOS+PFHxS TDI			Actual food consumption~ (grams/day)		
		Grams/day	Serves of foods /day	Approximate frequency of consumption	P90 (consumers only)	Mean (consumers only)	
Fruit	Berries and small fruit	Mulberry#	1750	Approx 116 serves (1 serve of 8 mulberries = 15 g)	About 816 serves of mulberries per week	526	166
		Citrus	Grapefruit#	1750	Approx 6½ grapefruits (1 grapefruit = 260 g)	About 47 serves of grapefruit per week	354
		Lemon#	1750	Approx 23 lemons (1 lemon = 75 g)	About 163 serves of lemons per week		
		Lime#	1750	Approx 35 limes (1 lime = 50 g)	About 245 serves of limes per week		
	Curcubits	Melon#	1750	Approx 23 slices melon (1 slice melon = 75 g)	About 163 serves of melon per week	96	35
		Watermelon#					
	Tropical fruit edible peel	Dragon fruit#	1750	Approx 9½ dragon fruits (1 dragon fruit = 180 g)	About 68 serves of dragon fruit per week	10	5
		Starfruit#	1750	Approx 19 starfruits (1 starfruit = 90 g)	About 136 serves of starfruit per week		
	Tropical fruit inedible peel	Banana#	1750	Approx 17½ bananas (1 banana, medium = 100 g)	About 122 serves of bananas per week	111	65
	Tropical fruit IP ex banana	Black sapote#	1750	Approx 3½ black sapotes (1 black sapote fruit = 450 g)	About 27 serves of black sapote per week	111	42
		Custard apple#	1750	Approx 3½ custard apples (1 custard apple = 450 g)	About 27 serves of custard apple per week		
		Jackfruit#	1750	Approx 23 slices jackfruit (1 slice jackfruit = 75 g)	About 163 serves of jackfruit per week		
		Longan#	1750	Approx 116 longans (1 longan = 15 g)	About 816 serves of longan per week		
		Mango	1750	Approx 5½ mangoes (1 mango, medium = 295 g)	About 41 serves mango per week		
		Papaya/pawpaw#	1750	Approx 23 slices papaya (1 slice papaya = 75 g)	About 163 serves of papaya per week		

^ Measures taken from AUSNUT 2011-12 Measures File [AUSNUT Food Measures File](#)

* Tolerable daily intake for PFOS and PFOS+PFHxS combined is 0.02 µg/kg body weight/day

~ Actual food consumption as reported in the 2011-12 Australian National Nutrition and Physical Activity Survey

Limited data (< 10 data points)

Table 9 Amount of vegetables at median PFOS+PFHxS combined concentration that can be consumed every day over a lifetime before reaching the TDI* for the population aged 2+ years (expressed as grams/day, serves/day^ and frequency of consumption)

Matrix	Species		Amount of food that can be consumed before reaching PFOS+PFHxS TDI			Actual food consumption~ (grams/day)	
			Grams/day	Serves of foods /day	Approximate frequency of consumption	P90 (consumers only)	Mean (consumers only)
Vegetables	Curcubits	Pumpkin#	1750	Approx 17½ roast pumpkin (1 piece pumpkin = 100 g)	About 122 serves of pumpkin per week	96	35
	Herbs & spices	Basil#	1555			4	2
		Chilli#	2333	Approx 155 fresh chillies (1 chilli = 15 g)	About 1088 serves of chilli per week	5	2
		Chives#	1166			4	2
		Lemongrass#	2333			4	2
	Leafy vegetables	Spinach#	2333	Approx 155 serves leaves (1 serve = 15 g)	About 1088 serves of leaves per week	48	22
		Drumstick/ Moringa#					
	Legumes	Green beans#	2333	Approx 51 serves beans (1 serve 10 beans = 45 g)	About 362 serves of green beans per week	25	10
	Other fruiting vegetables	Capsicum#	2333	Approx 9 capsicum, whole (1 capsicum, medium = 250 g)	About 65 serves of capsicum per week	205	104
		Corn#	2333	Approx 20 serves corn cob (kernels from 1 cob = 115 g)	About 142 corn cobs per week		
		Eggplant#	2333	Approx 7 eggplants (1 eggplant, medium = 330 g)	About 49 serves of eggplant per week		
		Okra#	2333	Approx 233 okra (1 okra = 10 g)	About 1633 serves of okra per week		
		Tomato	1750	Approx 11½ tomatoes (1 tomato, medium = 150 g)	About 81 serves of tomato per week		
	Roots & tubers	Beetroot#	1750	Approx 17½ pieces of beetroot (1 piece beetroot = 100 g)	About 122 serves of beetroot per week	273	123
		Carrot#	2000	Approx 15 carrots (1 carrot, medium = 130 g)	About 107 serves of carrot per week		
		Radish#	2333	Approx 116 radish (1 radish = 20 g)	About 816 serves of radish per week		
		Sweet potato#	2333	Approx 23 pieces roast sweet potato (1 piece sweet potato = 100 g)	About 163 serves sweet potato per week		
		Taro#	1400	Approx 14 pieces roast taro (1 piece taro = 100 g)	About 98 serves of taro per week		

Matrix	Species	Amount of food that can be consumed before reaching PFOS+PFHxS TDI			Actual food consumption~ (grams/day)	
		Grams/day	Serves of foods /day	Approximate frequency of consumption	P90 (consumers only)	Mean (consumers only)
	<i>Tree nuts</i>	Coconut [#]	Approx 17½ serve coconut flesh (1 handful coconut flesh = 100 g)	About 122 serves coconut flesh per week	21	10
		1750				

^ Measures taken from AUSNUT 2011-12 Measures File [AUSNUT Food Measures File](#)

* Tolerable daily intake for PFOS and PFOS+PFHxS combined is 0.02 µg/kg body weight/day

~ Actual food consumption as reported in the 2011-12 Australian National Nutrition and Physical Activity Survey

Limited data (<10 data points)

Table 10 Amount of fish, fish livers and crustacea with a sample size ≥ 25 at median PFOS+PFHxS combined concentration that can be consumed every day over a lifetime before reaching the TDI* for children aged 2-6 years (expressed as grams/day, serves/day^ and frequency of consumption)

Matrix	Fish species	Amount of food that can be consumed before reaching PFOS+PFHxS TDI			Actual food consumption [~] (grams/day)	
		Grams/day	Serves of foods /day	Approximate frequency of consumption	P90 (consumers only)	Mean (consumers only)
Fish flesh	All species	21	Approx 1/4 fillet (1 fillet/cutlet = 75 g)	About 2 serves of a range of fish per week	73	24
	Diadromous fish	33	Approx 2/5 fillet (1 fillet/cutlet = 75 g)	About 3 serves of a range of fish per week		
	Barramundi	38	Approx 1/2 fillet (1 fillet/cutlet = 75 g)	About 3 serves of Barramundi per week		
	Freshwater fish	19	Approx 1/4 fillet (1 fillet/cutlet = 75 g)	About 1 serve of a range of fish per week		
	Black Catfish	14	Approx 1/8 fillet (1 fillet/cutlet = 75 g)	About 1 serves of Black Catfish per week		
	Bony Bream	29	Approx 2/5 fillet (1 fillet/cutlet = 75 g)	About 2 serves of Bony Bream per week		
	Ord River Mullet	20	Approx 1/4 fillet (1 fillet/cutlet = 75 g)	About 1 serve of Ord River Mullet per week		
	Sleepy Cod	32	Approx 2/5 fillet (1 fillet/cutlet = 75 g)	About 3 serves of Sleepy Cod per week		
	Sooty Grunter	26	Approx 1/3 fillet (1 fillet/cutlet = 75 g)	About 2 serves of Sooty Grunter per week		
Fish liver	All species	3	Approx 3/4 liver (1 liver = 5 g)	About 5 livers from a range of fish per week		5 [#]
	Diadromous fish	3	Approx 3/4 liver (1 liver = 5 g)	About 5 livers from a range of fish per week		
	Freshwater fish	3	Approx 3/4 liver (1 liver = 5 g)	About 5 livers from a range of fish per week		
Crustacea	Cherabin	7	Approx 1/2 serve (1 serve cherabin meat = 11 g)	About 4 serves of cherabin meat per week	21	8

[^] Measures taken from AUSNUT 2011-12 Measures File [AUSNUT Food Measures File](#)

* Tolerable daily intake for PFOS and PFOS+PFHxS combined is 0.02 µg/kg body weight/day

[~] Actual food consumption for all fish and seafood as reported in the 2011-12 Australian National Nutrition and Physical Activity Survey

[#] no food consumption data available, Population 2+ years, median consumption assumed to be 5 g (weight of one liver). Source: FSANZ report on Edith River, Northern Territory 2013, https://dpir.nt.gov.au/_data/assets/pdf_file/0006/260187/TraceElementsNTFish.pdf

Table 11 Amount of animal products at median PFOS+PFHxS combined concentration that can be consumed every day over a lifetime before reaching the TDI* for children aged 2-6 years (expressed as grams/day, serves/day^ and frequency of consumption)

Matrix	Species	Amount of food that can be consumed before reaching PFOS+PFHxS TDI			Actual food consumption~ (grams/day)	
		Grams/day	Serves of foods /day	Approximate frequency of consumption	P90 (consumers only)	Mean (consumers only)
Mammalian meat	Freshwater Crab	8	Approx 3/4 serve (1 serve crab meat = 11 g)	About 5 serves of crab meat per week		
	Cattle	131	Approx 1/2 beef steak (1beef steak = 200 g)	About 4 serves of beef per week	85	33
	Goat [#]	82	Approx ½ serve goat meat (1 serve goat pieces = 120 g)	About 4 serves of goat per week	113	56
	Pig [#]	316	Approx 2½ pork steaks (1 pork steak = 120 g)	About 18 serves of pork per week	34	13
	Sheep [#]	316	Approx 7 lamb chops (1 loin chop, medium = 45 g)	About 49 serves of lamb per week	36	9
Poultry eggs	Chicken	100	Approx 2 chicken eggs (1 large chicken egg = 50 g)	About 14 chicken eggs per week	36	13
	Duck [#]	7	Approx 1/8 duck egg (1 duck egg = 60g)	About 3 duck eggs per month		
	Turkey [#]	8	Approx 1/8 turkey egg (1 turkey egg = 50 g)	About 4 turkey eggs per month		
Poultry meat	Chicken	345	Approx 2½ serves chicken (1 serve chicken pieces = 120 g)	About 20 serves chicken per week	94	37
	Duck [#]	61	Approx ½ serves duck (1 serve duck pieces = 90 g)	About 4 serves duck per week	29	2

^ Measures taken from AUSNUT 2011-12 Measures File [AUSNUT Food Measures File](#)

* Tolerable daily intake for PFOS and PFOS+PFHxS combined is 0.02 µg/kg body weight/day

~ Actual food consumption as reported in the 2011-12 Australian National Nutrition and Physical Activity Survey

[#] Limited data (<10 data points)

Table 12 Amount of fruit at median PFOS+PFHxS combined concentration that can be consumed every day over a lifetime before reaching the TDI* for children aged 2-6 years (expressed as grams/day, serves/day^ and frequency of consumption)

Matrix	Species	Amount of food that can be consumed before reaching PFOS+PFHxS TDI				Actual food consumption~ (grams/day)	
		Grams/day	Serves of foods /day	Approximate frequency of consumption	P90 (consumers only)	Mean (consumers only)	
Fruit	Berries and small fruit	Mulberry#	475	Approx 31 serves (1 serve of 8 mulberries = 15 g)	About 221 serves of mulberries per week	108	38
		Citrus	Grapefruit#	475	Approx 1½ grapefruits (1 grapefruit = 260 g)	About 12 serves of grapefruit per week	246
		Lemon#	475	Approx 6 lemons (1 lemon = 75 g)	About 44 serves of lemons per week		
		Lime#	475	Approx 9½ limes (1 lime = 50 g)	About 66 serves of limes per week		
	Curcubits	Melon#	475	Approx 6 slices melon (1 slice melon = 75 g)	About 44 serves of melon per week	115	35
		Watermelon#					
	Tropical fruit edible peel	Dragon fruit#	475	Approx 2½ dragon fruits (1 dragon fruit = 180 g)	About 18 serves of dragon fruit per week	10	5
		Starfruit#	475	Approx 5 starfruits (1 starfruit = 90 g)	About 36 serves of starfruit per week		
	Tropical fruit inedible peel	Banana#	475	Approx 4½ bananas (1 banana, medium = 100 g)	About 33 serves of bananas per week	111	61
	Tropical fruit IP ex banana	Black sapote#	475	Approx 1 black sapote (1 black sapote fruit = 450 g)	About 7 serves of black sapote per week	94	36
		Custard apple#	475	Approx 1 custard apple (1 custard apple = 450 g)	About 7 serves of custard apple per week		
		Jackfruit#	475	Approx 6 slices jackfruit (1 slice jackfruit = 75 g)	About 44 serves of jackfruit per week		
		Longan#	475	Approx 31½ longans (1 longan = 15 g)	About 221 serves of longan per week		
		Mango	475	Approx 1½ mangoes (1 mango, medium = 295 g)	About 11 serves mango per week		
		Papaya/pawpaw#	475	Approx 6 slices papaya (1 slice papaya = 75 g)	About 44 serves of papaya per week		

^ Measures taken from AUSNUT 2011-12 Measures File [AUSNUT Food Measures File](#)

* Tolerable daily intake for PFOS and PFOS+PFHxS combined is 0.02 µg/kg body weight/day

~ Actual food consumption as reported in the 2011-12 Australian National Nutrition and Physical Activity Survey

Limited data (<10 data points)

Table 13 Amount of vegetables at median PFOS+PFHxS combined concentration that can be consumed every day over a lifetime before reaching the TDI* for children aged 2-6 years (expressed as grams/day, serves/day^ and frequency of consumption)

Matrix	Species	Amount of food that can be consumed before reaching PFOS+PFHxS TDI			Actual food consumption~ (grams/day)		
		Grams/day	Serves of foods /day	Approximate frequency of consumption	P90 (consumers only)	Mean (consumers only)	
Vegetables	Curcubits	Pumpkin [#]	1750	Approx 4½ roast pumpkin (1 piece pumpkin = 100 g)	About 33 serves of pumpkin per week	115	35
	Herbs & spices	Basil [#]	1555			2	1
		Chilli, fresh [#]	2333	Approx 42 fresh chillies (1 chilli = 15 g)	About 295 serves of chilli per week		
		Chives [#]	1166				
		Lemongrass [#]	2333				
	Leafy vegetables	Spinach [#]	2333	Approx 42 serves leaves (1 serve = 15 g)	About 295 serves of leaves per week	26	9
		Drumstick/ Moringa [#]					
	Legumes	Green beans [#]	2333	Approx 14 serves beans (1 serve 10 beans = 45 g)	About 98 serves of green beans per week	13	5
	Other fruiting vegetables	Capsicum [#]	2333	Approx 2½ capsicum, whole (1 capsicum, medium = 250 g)	About 17 serves of capsicum per week	151	73
		Corn [#]	2333	Approx 5½ serves corn cob (kernels from 1 cob = 115 g)	About 326 corn cobs per week		
		Eggplant [#]	2333	Approx 1½ eggplants (1 eggplant, medium = 330 g)	About 13 serves of eggplant per week		
		Okra [#]	2333	Approx 63 okra (1 okra = 10 g)	About 443 serves of okra per week		
		Tomato	1750	Approx 3 tomatoes (1 tomato, medium = 150 g)	About 22 serves of tomato per week		
	Roots & tubers	Beetroot [#]	1750	Approx 4½ pieces of beetroot (1 piece beetroot = 100 g)	About 33 serves of beetroot per week	164	66
		Carrot [#]	2000	Approx 4 carrots (1 carrot, medium = 130 g)	About 29 serves of carrot per week		
		Radish [#]	2333	Approx 31½ radish (1 radish = 20 g)	About 221 serves of radish per week		
		Sweet potato [#]	2333	Approx 6 pieces roast sweet potato (1 piece sweet potato = 100 g)	About 44 serves sweet potato per week		
		Taro [#]	1400	Approx 3½ pieces roast taro (1 piece taro = 100 g)	About 26 serves of taro per week		

Matrix	Species	Amount of food that can be consumed before reaching PFOS+PFHxS TDI			Actual food consumption~ (grams/day)		
		Grams/day	Serves of foods /day	Approximate frequency of consumption	P90 (consumers only)	Mean (consumers only)	
	Tree nuts	Coconut#	1750	Approx 4½ serve coconut flesh (1 handful coconut flesh = 100 g)	About 33 serves coconut flesh per week	12	4

^ Measures taken from AUSNUT 2011-12 Measures File [AUSNUT Food Measures File](#)

* Tolerable daily intake for PFOS and PFOS+PFHxS combined is 0.02 µg/kg body weight/day

~ Actual food consumption as reported in the 2011-12 Australian National Nutrition and Physical Activity Survey

[#] Limited data (<10 data points)

Attachment 1

Table 1 Summary concentration data ($\mu\text{g/kg}$) of PFOA by fish and seafood species analysed in the Katherine area

Commodity Group		Count	Count of <LOR	Minimum	Maximum	Mean**	Median**
Crustacea	Total	55	55	<LOR	<LOR	0.4	0.5
	Cherabin	39	39	<LOR	<LOR	0.5	0.5
	Freshwater crab	16	16	<LOR	<LOR	0.3	0.3
Diadromous fish	Total	69	69	<LOR	<LOR	0.5	0.5
	Barramundi	67	67	<LOR	<LOR	0.5	0.5
	Tarpon [#]	2	2	<LOR	<LOR	0.5	0.5
Diadromous fish liver	Total	17	17	<LOR	<LOR	0.5	0.5
	Barramundi	17	17	<LOR	<LOR	0.5	0.5
Freshwater fish	Total	230	230	<LOR	<LOR	0.5	0.5
	Archerfish [#]	3	3	<LOR	<LOR	0.4	0.5
	Barred Grunter [#]	8	8	<LOR	<LOR	0.5	0.5
	Black Catfish	37	37	<LOR	<LOR	0.5	0.5
	Blue Catfish [#]	6	6	<LOR	<LOR	0.5	0.5
	Bony Bream	54	54	<LOR	<LOR	0.5	0.5
	Butler's Grunter [#]	6	6	<LOR	<LOR	0.5	0.5
	Catfish ^{#^}	1	1	<LOR	<LOR	0.5	
	Mullet	11	11	<LOR	<LOR	0.5	0.5
	Ord River Mullet	31	31	<LOR	<LOR	0.5	0.5
	Sleepy Cod	36	36	<LOR	<LOR	0.5	0.5
	Sooty Grunter	37	37	<LOR	<LOR	0.5	0.5
Freshwater fish liver	Total	27	25	<LOR	0.7	0.5	0.5
	Blue Catfish liver ^{#^}	1	1	<LOR	<LOR	0.5	
	Bony Bream liver [#]	3	2	<LOR	0.6	0.5	0.5
	Butler's Grunter liver ^{#^}	1	1	<LOR	<LOR	0.5	
	Mullet liver	2	1	<LOR	0.7	0.6	0.6
	Ord River Mullet liver [#]	6	6	<LOR	<LOR	0.5	0.5
	Sleepy Cod liver	10	10	<LOR	<LOR	0.5	0.5

Commodity Group	Count	Count of <LOR	Minimum	Maximum	Mean**	Median**
Sooty Grunter liver [#]	4	4	<LOR	<LOR	0.5	0.5

** Upper bound mean and median derived where not detected results are assigned a concentration equal to LOR

[#] Limited data (<10 data points)

[^] Upper bound median value not calculated where only 1 sample, the upper bound mean was used as the upper bound concentration in estimates of number of serves that can be consumed (assigned the relevant LOR if not detected)

Table 2 Summary concentration data ($\mu\text{g/kg}$) of PFOS+PFHxS by fish and seafood species analysed in the Katherine area

Commodity Group		Count	Count of <LOR	Minimum	Maximum	Mean**	Median**
Crustacea	Total	55	0	0.7	90.2	46.2	49.9
	Cherabin	39	0	0.7	90.2	47.4	54.2
	Freshwater crab	16	0	37	49.9	43.5	43.5
Diadromous fish	Total	67	3	<LOR	271	20.9	11.3
	Barramundi	65	3	<LOR	62.3	15.6	9.9
	Tarpon [#]	2	0	110.5	271	190.8	190.8
Diadromous fish liver	Total	17	0	3.4	820.4	156.7	100.3
	Barramundi	17	0	3.4	820.4	156.7	100.3
Freshwater fish	Total	228	9	<LOR	380.5	43.4	19.3
	Archerfish [#]	2	0	19	81.9	50.6	50.6
	Barred Grunter [#]	8	0	3.5	161	48.7	23.8
	Black Catfish	37	1	<LOR	204.1	56.0	26.5
	Blue Catfish [#]	6	0	6.2	35.3	16.4	12.3
	Bony Bream	54	4	<LOR	150.3	33.6	12.8
	Butler's Grunter [#]	6	0	49	160.3	99.5	100.3
	Catfish ^{#^}	1	0	34	34.3	34.3	
	Mullet	10	0	48	351.2	117.4	89.8
	Ord River Mullet	31	0	0.9	380.5	69.0	18.3
	Sleepy Cod	36	0	<LOR	88.3	20.2	11.8
	Sooty Grunter	37	0	0.3	78.3	20.3	14.3
Freshwater fish liver	Total	27	1	<LOR	1406	205.7	97.3
	Blue Catfish liver ^{#^}	1	0	212.0	212.0	212.0	
	Bony Bream liver [#]	3	0	12	443.8	181.8	89.3
	Butler's Grunter liver ^{#^}	1	0	300.6	300.6	300.6	
	Mullet liver	2	0	77.4	1406	741.7	741.7
	Ord River Mullet liver [#]	6	0	17	781.8	270.0	195.6
	Sleepy Cod liver	10	1	<LOR	260.4	80.0	50.3
	Sooty Grunter liver [#]	4	0	51	310.4	148.1	115.3

** Upper bound mean and median derived where not detected results are assigned a concentration equal to LOR, for PFOS+PFHxS combined not detected results are assigned a concentration equal to the sum of the LOR for each chemical

Limited data (<10 data points)

^ Upper bound median value not calculated where only 1 sample, the upper bound mean was used as the upper bound concentration in estimates of number of serves that can be consumed (assigned the relevant LOR if not detected)

Attachment 2

Table 1. Proposed trigger points for investigation

Food	Food classification	Proposed trigger points for investigation (µg/kg)		Derivation
		PFOS, PFOS+ PFHxS combined	PFOA	
Fish and Seafood	Crustaceans and Molluscs [#]	65	520	Children 2-6 years, median consumption
	Finfish (all)	5.2	41	Children 2-6 years, P90 consumption
	Fish liver [#]	280	2240	Population 2+ years, median consumption assumed to be 5 g (weight of one liver)*
Animal Products	Meat mammalian	3.5	28	Children 2-6 years, P90 consumption
	Milk	0.4 or LOD if higher	2.8	Children 2-6 years, P90 consumption
	Honey	33	264	Children 2-6 years, P90 consumption
	Offal mammalian [#]	96	765	Population 2+ years, median consumption
	Poultry eggs	11	85	Children 2-6 years, P90 consumption
	Poultry meat [^]	4	32	Children 2-6 years, P90 consumption
Fruits and vegetables	Fruit (all)	0.6 or LOD if higher	5.1	Children 2-6 years, P90 consumption
	Vegetables (all)	1.1 or LOD if higher	8.8	Children 2-6 years, P90 consumption

[#] occasionally consumed food, trigger points for investigation for crustaceans applied to molluscs due to small number of consumers of molluscs

[^] proposed new trigger level for poultry meat

* no food consumption data available, source: FSANZ report on Edith River, Northern Territory 2013, https://dpir.nt.gov.au/_data/assets/pdf_file/0006/260187/TraceElementsNTFish.pdf

Attachment 3

Table 1 Amount of fish and fish livers at median PFOS+PFHxS combined concentration that can be consumed every day over a lifetime before reaching the TDI* for the population aged 2+ years (expressed as grams/day, serves/day^ and frequency of consumption)

Matrix	Fish species	Amount of food that can be consumed before reaching PFOS+PFHxS TDI			Actual food consumption~ (grams/day)	
		Grams/day	Serves of foods /day (1 fillet/cutlet = 150 g)	Approximate frequency of consumption (1 serve = 150 g)	P90 (consumers only)	Mean (consumers only)
Fish flesh	All species	80	Approx ½ fillet	About 3 serves of a range of fish per week	143	56
	Barramundi	141	Approx 9/10 fillet	About 6 serves of Barramundi per week		
	Tarpon [#]	7	Approx 1/25 fillet	About 1 serve of Tarpon per month		
	Archerfish [#]	27	Approx 1/8 fillet	About 1 serve Archerfish per week		
	Barred Grunter [#]	58	Approx 1/4 fillet	About 2 serves of Barred Grunter per week		
	Black Catfish	52	Approx 1/4 fillet	Approx 2 serves of Black Catfish per week		
	Blue Catfish [#]	113	Approx 3/4 fillet	About 5 serves of Blue Catfish per week		
	Bony Bream	109	Approx 3/4 fillet	About 5 serves Bony Bream per week		
	Butler's Grunter [#]	13	Approx 1/20 fillet	About 2 serves Butler's Grunter per month		
	Catfish [#]	40	Approx 1/4 fillet	About 1 serve Catfish per week		
	Mullet	15	Approx 1/10 fillet	About 3 serves Mullet per month		
	Ord River Mullet	107	Approx ½ fillet	About 3 serves Ord River Mullet per week		
	Sleepy Cod	118	Approx 3/4 fillet	About 5 serves Sleepy Cod per week		
	Sooty Grunter	80	Approx ½ fillet	About 4 serves of Sooty Grunter per week		
Fish liver	All species	14	Approx 2½ livers	About 19 serves fish liver from a range of species per week		5 ^{##}
	Barramundi	13	Approx 2½ livers	About 19 serves Barramundi liver per week		
	Blue Catfish [#]	6	Approx 1 liver	About 9 serves Blue Catfish liver per week		
	Bony Bream [#]	15	Approx 3 liver	About 21 serves Bony Bream liver per week		
	Butler's Grunter [#]	4	< 1 liver	About 6 serves Butler's Grunter liver per week		
	Mullet [#]	1	Approx 1/3 liver	About 2 serves Mullet liver per week		
	Ord River Mullet [#]	7	Approx 1 liver	About 10 serves Ord River Mullet liver per week		
	Sleepy Cod	27	Approx 5½ livers	About 38 serves Sleepy Cod liver per week		
	Sooty Grunter [#]	12	Approx 2 livers	About 17 serves of Sooty Grunter liver per week		

^ Measures taken from AUSNUT 2011-12 Measures File, measure for prawns applied to all crustacea [AUSNUT Food Measures File](#)

* Tolerable daily intake for PFOS and PFOS+PFHxS combined is 0.02 µg/kg body weight/day

[#] Limited data (<10 data points)

~ Actual food consumption for all fish as reported in the 2011-12 Australian National Nutrition and Physical Activity Survey

^{##} no food consumption data available, Population 2+ years, median consumption assumed to be 5 g (weight of one liver). Source: FSANZ report on Edith River, Northern Territory 2013, https://dpir.nt.gov.au/_data/assets/pdf_file/0006/260187/TraceElementsNTFish.pdf

Table 2 Amount of fish and fish livers at median PFOS+PFHxS combined concentration that can be consumed every day over a lifetime before reaching the TDI* for children aged 2-6 years (expressed as grams/day, serves/day^ and frequency of consumption)

Matrix	Fish species	Amount of food that can be consumed before reaching PFOS+PFHxS TDI			Actual food consumption~ (grams/day)	
		Grams/day	Serves of foods /day (1 fillet/cutlet = 75 g)	Approximate frequency of consumption (1 serve = 75 g)	P90 (consumers only)	Mean (consumers only)
Fish flesh	All species	21	Approx 1/4 fillet	About 2 serves of a range of fish per week	73	24
	Barramundi	38	Approx ½ fillet	About 3 serves of Barramundi per week		
	Tarpon [#]	2	Approx 1/50 fillet	< 1 serve of Tarpon per month		
	Archerfish [#]	7	Approx 1/10 fillet	About 3 serves Archerfish per month		
	Barred Grunter [#]	16	Approx 1/5 fillet	About 1 serve of Barred Grunter per week		
	Black Catfish [#]	14	Approx 1/5 fillet	Approx 1 serves of Black catfish per week		
	Blue Catfish [#]	30	Approx 2/5 fillet	About 2 serves of Blue Catfish per week		
	Bony Bream [#]	29	Approx 2/5 fillet	About 2 serves Bony Bream per week		
	Butler's Grunter [#]	3	Approx 1/20 fillet	About 1 serve Butler's Grunter per month		
	Catfish [#]	11	Approx 1/8 fillet	About 1 serve Catfish per week		
	Mullet	4	Approx 1/20 fillet	About 1 serve Mullet per month		
	Ord River Mullet	20	Approx 1/4 fillet	About 1 serve Ord River Mullet per week		
	Sleepy Cod	32	Approx 2/5 fillet	About 3 serves Sleepy Cod per week		
	Sooty Grunter	26	Approx 1/3 fillet	About 2 serves Sooty Grunter per month		
Fish liver	All species	3	< 1 liver	About 5 serves fish liver from a range of species per week		5 ^{##}
	Barramundi	3	< 1 liver	About 5 serves Barramundi liver per week		
	Blue Catfish [#]	1	< 1 liver	About 2 serves Blue Catfish liver per week		
	Bony Bream [#]	4	< 1 liver	About 5 serves Bony Bream liver per week		
	Butler's Grunter [#]	1	< 1 liver	About 1 serve Butler's Grunter liver per week		
	Mullet [#]	0.5	< 1 liver	About 3 serves Mullet liver per month		
	Ord River Mullet [#]	1	< 1 liver	About 2 serves Ord River Mullet liver per week		
	Sleepy Cod	7	Approx 1 ½ livers	About 10 serves Sleepy Cod liver per week		
	Sooty Grunter [#]	3	< 1 liver	About 4 serves of Sooty Grunter liver per week		

^ Measures taken from AUSNUT 2011-12 Measures File, measure for prawns applied to all crustacea [AUSNUT Food Measures File](#)

* Tolerable daily intake for PFOS and PFOS+PFHxS combined is 0.02 µg/kg body weight/day

Limited data (<10 data points)

~ Actual food consumption for all fish as reported in the 2011-12 Australian National Nutrition and Physical Activity Survey

no food consumption data available, Population 2+ years, median consumption assumed to be 5 g (weight of one liver). Source: FSANZ report on Edith River, Northern Territory 2013, https://dpiir.nt.gov.au/_data/assets/pdf_file/0006/260187/TraceElementsNTFish.pdf